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| 09/469,652 | 12/22/1999 | JONATHAN J. WIERER JR. | 10992873-1 | 5235 |

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EXAMINER

CHU, CHRIS C

ART UNIT PAPER NUMBER

2815

DATE MAILED: 11/04/2002

20

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/469,652

Applicant(s)

WIERER ET AL.

Examiner

Chris C. Chu

Art Unit

2815

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 09 August 2002.
- 2a) ☐ This action is FINAL. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1, 3 - 11 and 13 - 18 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1, 3 - 11 and 13 - 18 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☒ The proposed drawing correction filed on 09 July 2002 is: a) ☐ approved b) ☒ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____.
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. Applicant's amendment filed on August 9, 2002 has been received and entered in the case.

Drawings

2. The drawings are objected to as failing to comply with 37 CFR 1.84(p)(5) because they include the following reference sign(s) not mentioned in the description: reference character 21 in Figure 4 of the proposed drawing is not described in the specification.

Correction is required.

3. Applicant is required to submit a proposed drawing correction in reply to this Office action. However, formal correction of the noted defect can be deferred until the application is allowed by the examiner.

Since applicant does not amend the drawing or specification or provide a remark, the objection to the drawing is maintained.

Claim Rejections - 35 USC § 103

4. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

5. Claims 1, 4, 8, 10, 11 and 14 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al. in view of Hunt et al.

Regarding claim 1, Biing-Jye et al. discloses in Fig. 2A and column 3, lines 22 ~ 24 a light emitting device comprising:

- a semiconductor heterostructure (Al_2O_3) including at least one p-type layer (p-GaN) and one n-type layer (n-GaN); and
- a p contact (p-ohmic) and an n contact (n-ohmic), the p contact electrically connected to the p-type layer, the n contact electrically connected to the n-type layer, wherein at least one of the p (p-ohmic) and n contacts is a multi-layer contact external to the semiconductor heterostructure and including a metallic reflector layer and a continuous conductive layer that makes ohmic contact through an uniform conducting sheet to the heterostructure (p-GaN).

Biing-Jye et al. does not disclose the multi-layer contact having a reflectivity greater than 75% for light at an operating wavelength of the light-emitting device. Hunt et al. discloses in Fig. 1 and column 2, line 67 ~ column 3, line 2 a multi-layer contact having a reflectivity greater than

Art Unit: 2815

75% for light at an operating wavelength of a light-emitting device. It would have been obvious to one of ordinary skill in the art at the time of the present invention was made to use the reflectivity greater than 75% of Hunt et al. in the light-emitting device of Biing-Jye et al. in order to enhance efficiencies as taught by Hunt et al. in column 1, lines 57 ~ 60.

Regarding claims 4 and 14, Hunt et al. discloses in column 2, lines 63 ~ 66 the multi-layer contact further comprising a barrier layer interposing the reflector layer and the conductive layer.

Regarding claim 8, Biing-Jye et al. discloses in Fig. 2A the p and n contacts are on opposing faces of the heterostructure.

Regarding claim 10, Hunt et al. discloses in column 3, lines 1 ~ 3 the reflector layer being Ag.

Regarding claim 11, Biing-Jye et al. discloses in Fig. 2A and column 3, lines 22 ~ 24 a light-emitting semiconductor device comprising:

- a GaN-based semiconductor heterostructure (GaN) having at least one p-type layer (p-GaN) and one n-type layer (n-GaN); and
- a p contact (p-ohmic) and an n contact (n-ohmic), the p contact electrically connected to the p-type layer, the n contact electrically connected to the n-type layer, wherein at least one of the p and n contacts is a multi-layer contact external to the semiconductor heterostructure and including a metallic reflector layer and a continuous conductive layer that makes ohmic contact through an uniform conducting sheet to the heterostructure.

Art Unit: 2815

Biing-Jye et al. does not disclose the multi-layer contact having a reflectivity greater than 75% for light at an operating wavelength of the light-emitting device. Hunt et al. discloses in Fig. 1 and column 3, lines 16 ~ 28 a multi-layer contact having a reflectivity greater than 75% for light at an operating wavelength of a light-emitting device. It would have been obvious to one of ordinary skill in the art at the time of the present invention was made to use the reflectivity greater than 75% of Hunt et al. in the light-emitting device of Biing-Jye et al. in order to enhance efficiencies as taught by Hunt et al. in column 1, lines 57 ~ 60.

6. Claims 3 and 13 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al. and Hunt et al. as applied to claims 1 and 11 above, and further in view of Sugiura et al.

Biing-Jye et al. and Hunt et al. do not disclose the contact resistance of the multi-layer contact of the light-emitting device, which is less than $0.01 \Omega\text{-cm}^2$. However, Sugiura et al. discloses in column 5, lines 27 – 32 a contact resistance of the multi-layer contact having less than $0.01 \Omega\text{-cm}^2$. It would have been obvious to one of ordinary skill in the art at the time of the present invention was made to use the contact resistance which is less than $0.01 \Omega\text{-cm}^2$ of Sugiura et al. in the light-emitting device of Biing-Jye et al. and Hunt et al. in order to improve ohmic contact as taught by Sugiura et al. in column 5, lines 26 ~ 28.

7. Claims 5 and 15 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al. and Hunt et al. as applied to claims 1 and 11 above, and further in view of Nakagawa et al.

Biing-Jye et al. and Hunt et al. disclose the claimed invention except the thickness of the reflector layer, which is greater than 500 angstroms. However, Nakagawa et al. discloses the thickness of the reflector layer to be "(Ti/Pd/Ag (400nm/200nm/1 μ m thick))" (column 19, lines 45 – 48). Thus, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to further modify Biing-Jye et al. by increasing the thickness of the reflector layer to be greater than 500 angstroms. The ordinary artisan would have been motivated to further modify Biing-Jye et al. in the manner described above for at least the purpose of increasing the reflection and to have a high quality semiconductor layer (column 19, line 57 – 59).

8. Claims 6 and 16 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al. and Hunt et al. as applied to claims 1 and 11 above, and further in view of Liu et al.

Biing-Jye et al. and Hunt et al. disclose all of the claimed invention except the thickness of the ohmic contact layer, which is less than 200 angstroms. However, Liu et al. discloses the thickness of the ohmic contact layer, which is less than 200 angstroms (column 4, lines 60 – 63). Thus, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to further modify Biing-Jye et al. by adding less than 200 angstroms for the thickness of the ohmic contact layer as taught by Liu et al. The ordinary artisan would have been motivated to further modify Biing-Jye et al. in the manner described above for at least the purpose of improving the transistor performances (column 2, lines 43 ~ 46).

Art Unit: 2815

9. Claims 7 and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al. and Hunt et al. as applied to claims 1 and 11 above, and further in view of Schetzina.

Biing-Jye et al. and Hunt et al. do not disclose the reflector layer being selected from a group that includes Al, Cu, Rh, Pd, and Au. Schetzina discloses in column 18, lines 48 ~ 50 a reflector layer being selected from a group that includes Al, Cu, Rh, Pd, and Au. It would have been obvious to one of ordinary skill in the art at the time of the present invention was made to select from the group that includes Al, Cu, Rh, Pd, and Au of Schetzina as the reflector layer in the light-emitting device of Biing-Jye et al. and Hunt et al. in order to provide an optically reflecting metal ohmic contact as taught by Schetzina in column 18, lines 48 ~ 53.

10. Claim 9 is rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al. and Hunt et al. as applied to claims 1 and 8 above, and further in view of Haitz et al.

Biing-Jye et al. and Hunt et al. do not disclose the conductive layer that makes ohmic contact to the heterostructure includes Ni and Ag. However, Haitz et al. discloses in column 3, lines 31 ~ 34 the conductive layer that makes ohmic contact to the heterostructure includes Ni and Ag. It would have been obvious to one of ordinary skill in the art at the time of the present invention was made to use Ni and Ag of Haitz et al. for the conductive layer in the light-emitting device of Biing-Jye et al. and Hunt et al. in order to improve reflectivity as taught by Haitz et al. in column 3, line 32.

11. Claim 18 is rejected under 35 U.S.C. 103(a) as being unpatentable over Biing-Jye et al. and Hunt et al. as applied to claim 11 above, and further in view of Okazaki.

Biing-Jye et al. and Hunt et al. disclose the claimed invention except the ohmic contact layer, which is selected from a group that consist of Ti, Au/NiO, and Ni/Au. However, Okazaki discloses that the material of the ohmic contact layer (13) is selected from a group of “titanium (Ti), nickel (Ni), etc.” (column 8, lines 9 – 14 and column 8, lines 32 – 37). Therefore, it would have been obvious to one of ordinary skill in the art at the time when the invention was made to further modify Biing-Jye et al. by selecting from a group that consist of Ti, Au/NiO, and Ni/Au for the ohmic contact layer as taught by Okazaki. The ordinary artisan would have been motivated to further modify Biing-Jye et al. in the manner described above for at least the purpose of decreasing the ohmic contact resistance between the layers and increasing the reflectivity of the ohmic contact layer.

Response to Arguments

12. Applicant's arguments with respect to claims 1 and 11 have been considered but are moot in view of the new ground(s) of rejection.

Conclusion

13. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Art Unit: 2815

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Chris C. Chu whose telephone number is (703) 305-6194. The examiner can normally be reached on M-F (10:30 - 7:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Eddie C. Lee can be reached on (703) 308-1690. The fax phone numbers for the organization where this application or proceeding is assigned are (703) 308-7382 for regular communications and (703) 308-7722 for After Final communications.

Any inquiry of a general nature or relating to the status of this application or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Chris C. Chu
Examiner
Art Unit 2815

c.c.
October 30, 2002

A handwritten signature in black ink, appearing to read 'Eddie Lee', with a large, sweeping loop at the top.

EDDIE LEE
SUPERVISOR, PATENT EXAMINER
TECHNOLOGY CENTER 2800